

## Importing rayfiles and ray-measurement files of LEDs from OSRAM Opto Semiconductors

### Application Note



#### Valid for:

all products from OSRAM Opto Semiconductors

### Abstract

Optical simulation software typically propagates light through a virtual optical system by ray tracing. Light sources can be defined by emitting rays from their surfaces or volumes. Many software packages accept rayfiles, which are virtual sources, created from measured or calculated sources. Each ray in the file has a starting point, a direction, and associated power. Some optical design software packages can additionally use wavelength information for the individual rays or consider an overall spectrum. OSRAM Opto Semiconductors provides rayfiles in several software formats. Furthermore, measurement files are also provided. The properties of these ray- and measurement files are described in this application note.



Further information:

Ray- and measurement files can be found on the homepage: [www.osram-os.com/rayfiles](http://www.osram-os.com/rayfiles)

Authors: Retsch Stefanie / Guenther Alexander

## Table of contents

A. Rayfile generation by near field measurement .....	2
B. Rayfile access process .....	2
C. Rayfiles .....	3
D. Measurement files .....	4
E. Additional considerations for white LED rayfiles .....	4
F. Spectral data .....	6
G. Import procedure summary .....	6

---

### A. Rayfile generation by near field measurement

For the generation of rayfiles by measurement, an LED sample with typical emission characteristics is used. The measurement is carried out in a near field goniometer. The basic principle of this method is a luminance camera on a moving arm, looking at the LED sample. The camera typically scans the upper hemisphere in a polar angular range of  $\sim \pm 100^\circ$  and with a typical resolution  $< 1^\circ$  in the polar as well as in the azimuthal direction. At each position of the camera a luminance picture is taken. A software algorithm evaluates the picture and generates rays according to the captured spatial luminance and the angular position of the camera.

### B. Rayfile access process

Ray- and measurement files can be found on the homepage of OSRAM Opto Semiconductors under “Application Support” in the section “Applications”. After selecting the link “Optical Simulation / Ray Files + Package CAD Data” either section “IR” or “LED” can be chosen.

The subfolders list the different product types of the respective application area and also the “Disclaimer and User Agreement” file. After selecting the group of interest, discrete LED names are shown. They also act as links to the individual rayfiles, where several formats are available.

To save the file locally, the desired link must be chosen. First the disclaimer has to be read and accepted. Afterwards, the file can be saved to a local drive by clicking the “Save” button. (These files are rather large, so it may take some time to download. Since the process time to “Open” or “Save” is roughly the same, “Save” is recommended.)

Each \*.zip package contains:

- Ray- or measurement files
- Info PDF: depicting the orientation of the rayfiles vs. the LED package
- CAD files (placeholder for mechanical design)
- Spectrum files
- Disclaimer

Please note that CAD files and rayfiles use the same coordinate system.

Next, refer to the info PDF (named \*\_info.pdf). It depicts the orientation of the rayfiles. This file contains a mechanical drawing of the LED, with an (x,y,z) axis system superimposed. It shows the orientation and location of the LED with respect to the original coordinate system.

The documentation file also contains information about the “virtual focus” of the specific rayfile. For OSRAM Opto Semiconductors’ rayfiles this “virtual focus” is defined as the point, having the smallest accumulated distance in 3D space to all the rays of the rayset. For the calculation of the virtual focus given, all rays are used. The values are provided with respect to the previously mentioned coordinate system.

The ray- or measurement files provided are only exemplary and imply the typical emission characteristic of this LED type. For this reason, the files provided do not guarantee that an LED which has been delivered shows exactly the same emission characteristic indicated in the rayfile package.

## C. Rayfiles

After opening the \*.zip package of a software specific rayfile format, rayfiles are available in three different sizes:

- 100,000 (100k) rays
- 500,000 (500k) rays
- 5,000,000 (5M) rays

The \*.zip package of the standardized IES TM25 rayfile format additionally contains a file with 20,000,000 (20M) rays. If larger ray counts are required, please contact your OSRAM Opto Semiconductors representative or use the measurement file to create a rayfile with the desired number of rays.

Before using the rayfiles, consider the following:

- If an optic needs to be designed around the LED, the best focus location has to be calculated. The procedure for doing so depends on the software package.
- The source flux for most rayfiles is set to a typical value.
- The OSRAM Opto Semiconductors rayfiles are made such that the starting

points of the rays must be in air.

The rayfile packages provided for Zemax and Lighttools contain a sample file / library element which includes all the necessary settings to start an optical simulation.

## D. Measurement files

When opening the \*TTR.zip package, the measurement file(s) (named \*\_TTR.ttr) will be found. This file type is created by the measurement device. To access data from the file, a special software called Converter801 is required. This software can be downloaded from the homepage of TechnoTeam Bildverarbeitung GmbH ([www.technoteam.de](http://www.technoteam.de)). To process measurement files from OSRAM Opto Semiconductors correctly, Converter801 Version 1.6.14.2 or higher is required.

After opening the measurement file with Converter801, different data sections can be accessed. The file provides common information about the LED and the measurement itself. The luminous intensity distribution for every polar scan can be displayed. Another section shows the rays of the camera images. In this section a visualization of the measured rays for every camera image is shown. A section for additional data contains on the one hand the data which can be found in the \*.zip package too, on the other hand some luminance images. These luminance images are measured additionally to create an impression of the light source.

Before the data of a measurement file (\*.ttr) can be used in simulation software, it needs to be converted into a rayfile. A geometry that defines the starting points of the rays is therefore required. A specific default geometry setting is included with in the measurement file. Further there are coordinate transformation values included. By using these coordinate transformation values, rayfiles are created with an orientation as shown in the information file, matching the other rayfiles in the \*.zip packages. Therefore, it is recommended to use the default values for geometry and coordinate transformation during the creation of a rayfile.

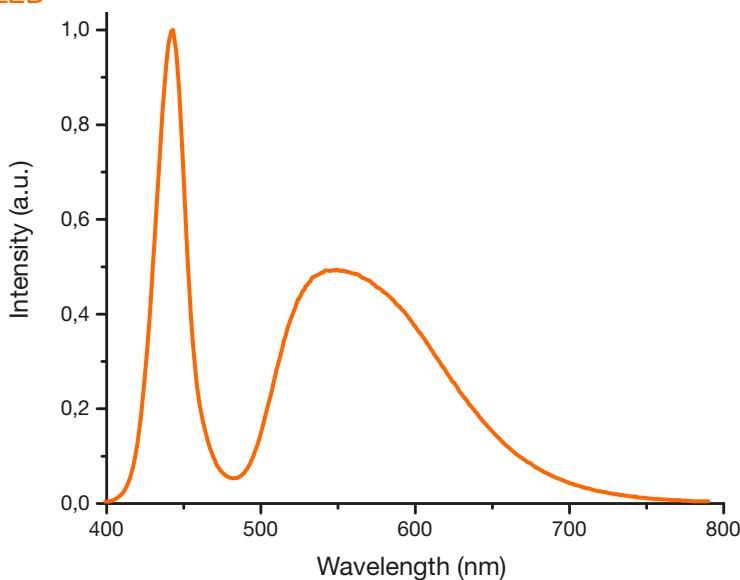
Rayfiles can be created by direct conversion or by batch processing. The number of rays and the flux can be adjusted. A spectral signature can be added by using an external spectrum file or the spectrum which is included within the measurement file.

## E. Additional considerations for white LED rayfiles

The spectra of OSRAM Opto Semiconductors white LEDs have at least two local maxima due to the specific generation of white light. The peak in the blue wavelength range has a narrow width and a peak wavelength around 450 nm. The peak in the yellow wavelength range has a wider distribution with a peak wavelength around 540 – 600 nm, depending on the LED type (see Figure 1 and Figure 2).

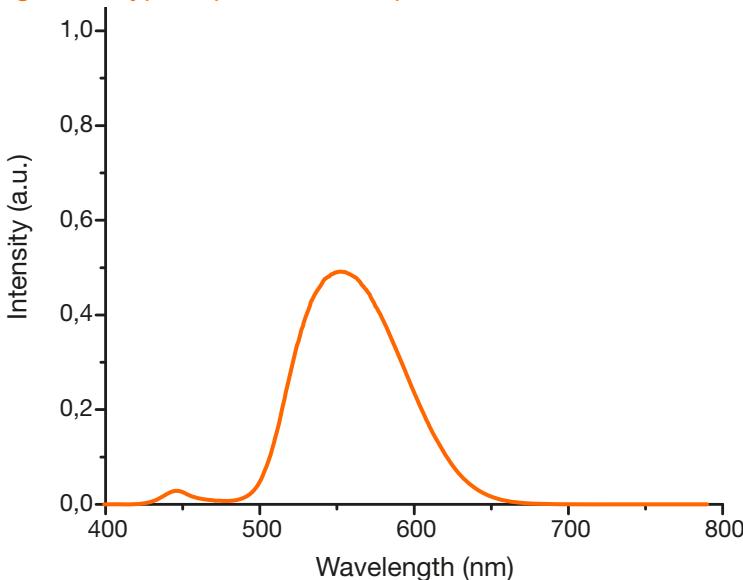
---

Figure 1: Typical radiometric spectrum for a white OSRAM Opto Semiconductors LED




---

Figure 2: Typical photometric spectrum for a white OSRAM Opto Semiconductors LED



Due to the different angular characteristics of rays in the “blue” and “yellow” parts of the spectrum, a separation of the ray model into two parts is necessary. Therefore, two rayfiles are delivered with each white LED, one rayfile for the blue and one rayfile for the yellow part of the spectrum. Both rayfiles have the same global coordinate origin and must be placed in the simulation software at exactly the same (x,y,z) coordinates. To use the rayfiles in a simulation, the user has to consider the following points:

- "Blue" and "yellow" rayfiles must be placed at the same (x,y,z) coordinates.
- Simulation should run simultaneously for the two rayfiles, as for two overlapping sources.
- The luminous flux contributions of both rayfiles must be set appropriately.

The luminous flux ratio between yellow and blue depends on the type of conversion material used for the specific LED. In addition, the ratio varies slightly for different color bins. Recommended luminous flux ratios are given in the \*.info.pdf.

To enable optical simulations for different color bins, flux ratios for some representative bins are given. In addition to the flux ratio, the related spectra must be imported. Spectrum files are provided also in the rayfile \*.zip packages. The CIE color coordinates calculated from the provided spectrum files could depend on the way the specific optical design software interprets the spectrum (e.g. interpolation between single values). It is recommended to check the resulting color coordinates and, in case of differences to the info PDF, to slightly adapt the blue/yellow weights to the needs of the specific calculation algorithm. It should be emphasized that no bidirectional relationship between a spectrum and a certain color point exists, e.g. in terms of the CIE chromaticity coordinates  $C_x/C_y$ . A certain color point can be generated with different spectra. Therefore, the spectrum files provided are only exemplary and do not guarantee that an LED delivered for a color bin has exactly the spectrum shown in the rayfile package.

## F. Spectral data

Spectrum files are provided as ASCII files in all rayfile packages. For white LEDs the spectrum is split up in a blue and yellow part, so two files are given in this case. For the SPEOS format the spectrum is already included in the rayset.

Some optical design software packages do not support the simulation of the complete color spectrum, but only single wavelengths. In this case, it is recommended to use the peak wavelength. For a white LED, the peak wavelength of the blue part of the spectrum should be used for the blue rayfile, and the peak wavelength of the yellow part of the spectrum should be used for the yellow rayfile. Please check the related spectrum file in order to identify the peak wavelength of the specific LED. In case of white rayfiles blue/yellow weights need to be adjusted.

## G. Import procedure summary

1. Download the \*.zip package containing the rayfiles and supporting documentation from the OSRAM Opto Semiconductors website.
2. Confirm the origin and orientation of the rayfiles from the orientation file.
3. Import the appropriate rayfiles into your optical software. If using a white LED, import both files, blue and yellow, with the same number of rays. For Zemax and Lighttools it is recommended to use the provided sample / library files.
4. Set the source flux to the desired value. (If using a white LED, set the flux ratio of yellow to blue.)
5. Enter appropriate spectral information.



**Don't forget:** LED Light for you is your place to be whenever you are looking for information or worldwide partners for your LED Lighting project.

[www.ledlightforyou.com](http://www.ledlightforyou.com)

## ABOUT OSRAM OPTO SEMICONDUCTORS

OSRAM, Munich, Germany is one of the two leading light manufacturers in the world. Its subsidiary, OSRAM Opto Semiconductors GmbH in Regensburg (Germany), offers its customers solutions based on semiconductor technology for lighting, sensor and visualization applications. OSRAM Opto Semiconductors has production sites in Regensburg (Germany), Penang (Malaysia) and Wuxi (China). Its headquarters for North America is in Sunnyvale (USA), and for Asia in Hong Kong. OSRAM Opto Semiconductors also has sales offices throughout the world. For more information go to [www.osram-os.com](http://www.osram-os.com).

## DISCLAIMER

**PLEASE CAREFULLY READ THE BELOW TERMS AND CONDITIONS BEFORE USING THE INFORMATION SHOWN HEREIN. IF YOU DO NOT AGREE WITH ANY OF THESE TERMS AND CONDITIONS, DO NOT USE THE INFORMATION.**

The information provided in this general information document was formulated using the utmost care; however, it is provided by OSRAM Opto Semiconductors GmbH on an "as is" basis. Thus, OSRAM Opto Semiconductors GmbH does not expressly or implicitly assume any warranty or liability whatsoever in relation to this information, including – but not limited to – warranties for correctness, completeness, marketability, fitness for any specific purpose, title, or non-infringement of rights. In no event shall OSRAM Opto Semiconductors GmbH be liable – regardless of the legal theory – for any direct, indirect, special, incidental, exemplary, consequential, or punitive damages arising from the use of this information. This limitation shall apply even if OSRAM Opto Semiconductors GmbH has been advised of possible damages. As some jurisdictions do not allow the exclusion of certain warranties or limitations of liabilities, the above limitations and exclusions might not apply. In such cases, the liability of OSRAM Opto Semiconductors GmbH is limited to the greatest extent permitted in law.

OSRAM Opto Semiconductors GmbH may change the provided information at any time without giving notice to users and is not obliged to provide any maintenance or support related to the provided information. The provided information is based on special conditions, which means that the possibility of changes cannot be precluded.

Any rights not expressly granted herein are reserved. Other than the right to use the information provided in this document, no other rights are granted nor shall any obligations requiring the granting of further rights be inferred. Any and all rights and licenses regarding patents and patent applications are expressly excluded.

It is prohibited to reproduce, transfer, distribute, or store all or part of the content of this document in any form without the prior written permission of OSRAM Opto Semiconductors GmbH unless required to do so in accordance with applicable law.

[OSRAM Opto Semiconductors GmbH](http://www.osram-os.com)

Head office:

Leibnizstr. 4  
93055 Regensburg  
Germany  
[www.osram-os.com](http://www.osram-os.com)

**OSRAM**  
Opto Semiconductors